40. The apparatus of Claim 39 wherein the micromirror device is formed of a two dimensional array of micromirrors.

41. The apparatus of Claim 39 including a lens for collimating the beam from the light source to provide a collimated beam projected onto the micromirror array at an oblique angle to a main optical axis that extends from the micromirror array to the substrate, and wherein in one position of each micromirror the light is reflected along the optical axis through the projection optics to the substrate and in a second position of each micromirror the light from the source is reflected at an angle off the main axis of the projection system and away from the substrate.

42. The apparatus of Claim 39 wherein the light source provides an output beam to a lens which collimates the output beam, and including a beam splitter positioned between the micromirror array and the projection optics and receiving the collimated beam from the source, the beam splitter reflecting a portion of the beam to the micromirror array and receiving reflected light from the micromirror array along a main optical axis of the apparatus that extends from the micromirror array through the projection optics to the substrate, the beam splitter partially passing the light from the micromirror therethrough to the projection optics to be imaged on the active surface of the substrate.

43. The apparatus of Claim 39 further including a filter receiving the light from the source and which selectively passes only desired wavelengths through to the micromirror array.

44. The apparatus of Claim 39 wherein the substrate is transparent and light from the image former is passed through the transparent substrate to be imaged on the active surface of the substrate which is opposite to the surface which initially receives the light from the image former.

45. The apparatus of Claim 43 further including a flow cell enclosing the active surface of the substrate and having ports for applying reagents into the flow cell which can be flowed over the active surface of the substrate.

46. The apparatus of Claim 39 further including a computer connected to the micromirror device to provide command signals to control the deflection of the mirrors in the micromirror array to provide a desired pattern for projection onto the substrate.

47. The apparatus of Claim 39 wherein the light provided by the light source is in the range of ultraviolet to near ultraviolet wavelengths.

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48. The apparatus of Claim 46 including a filter receiving the light from the source which selectively passes wavelengths in the ultraviolet and near ultraviolet and blocks longer wavelengths including infrared.

49. The apparatus of Claim 47 wherein the filter includes a dichroic mirror that reflects the selected wavelengths and passes the wavelengths to be blocked.

50. The apparatus of Claim 39 wherein the projection optics include focussing lenses and an adjustable iris, one of the lenses passing light through the adjustable iris and the other lens receiving the light passed through the iris and focussing that light onto the active surface of the substrate.

51. The apparatus of Claim 39 wherein the pattern of the micromirrors that is imaged onto the active surface of the substrate is reduced in size with respect to the size of the array of micromirrors.

52. The apparatus of Claim 39 wherein the projection optics is comprised of telecentric refractive optical elements, and including refractive lenses between the light source and the micromirror device that form a Kohler illumination system.

53. The apparatus of Claim 39 wherein the projection optics is telecentric and is comprised of reflective optical elements.

54. The apparatus of Claim 52 wherein the reflective optical elements include a concave mirror and a convex mirror, the concave mirror reflecting light from the micromirror device to the convex mirror which reflects it back to the concave mirror which reflects the light to the substrate where it is imaged.

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55. The apparatus of Claim 53 including a planar mirror that reflects the light from the concave mirror to the substrate.

56. The apparatus of Claim 39 including a flow cell enclosing the active surface of the substrate and having ports for applying reagents into the flow cell which can be flowed over the active surface of the substrate, and a DNA synthesizer connected to supply reagents to the flow cell.

57. The apparatus of Claim 39 including a flow cell having a housing composed of a lower base and upper cover section and a gasket mounted on the base, wherein the substrate is a transparent glass slide secured between the upper cover section and the base to define a sealed reaction chamber between the substrate and the base that is sealed by the gasket, and channels extending through the housing from the input port to the reaction chamber and from the reaction chamber to the output port, the active surface of the substrate facing the sealed reaction chamber.

58. The apparatus of Claim 56 including means for detachably securing the substrate between the lower base and upper cover section to allow the substrate to be replaced.

59. A method of synthesizing two-dimensional arrays of DNA probes comprising the steps of:

(a) providing a substrate with an active surface to which DNA synthesis linkers have been applied;

(b) providing a micromirror device comprising a two-dimensional array of electronically addressable micromirrors, each of which can be selectively tilted between one of at least two separate positions, and providing signals to the micromirror device to select a pattern of the micromirrors in the two-dimensional array which are to reflect light onto the substrate;

(c) projecting light from a source onto the micromirror array and reflecting the light from the mirrors of the micromirror array through projection optics to image the micromirror array onto the active surface of the substrate to illuminate those pixel sites in the array on the substrate active surface which are to be activated to deprotect OH groups thereon to make them available for binding to bases;

(d) providing a fluid containing an appropriate base to the active surface of the substrate and binding the selected base to the exposed sites;

(e) then providing control signals to the micromirror array device to select a new pattern of mirrors that are deflected to reflect light toward the substrate and repeating steps (c) through (e).

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60. The method of Claim 58 wherein steps (c) through (e) are repeated a selected number of times to build up a selected number of levels of bases in a two-dimensional probe array on the substrate.

61. The method of Claim 58 wherein a selected nucleotide base is flowed over the active surface in step (d) to bind to selected sites utilizing phosphoramidate DNA synthesis.

REMARKS

The claims of this amendment find support in the application of Garner as filed, specifically, claims 1-38 of the co-pending patent application filed June 4, 1999, Serial No. 09/326,526 (the " '526 application") and claims 1-18 of provisional application filed June 4, 1998, Serial No. 60/087,948. Further support for the claims of this amendment may be found in the above cited applications at page 17, l. 19 - page 25, l. 2, in which the creation of a nucleic and amino acid matrix is described, including the formation of arrays. Further support may be found in Figures 7 and 8 of the 60/087,948 application that demonstrate the chemical conjugation of a dye to an oligonucleotide on a substrate using UV directed oligonucleotide synthesis.

This amendment incorporates claims from Cerrina, et al., as published in International Application WO 99/42813. The WO 99/42813 application claims priority to an application filed in the United States PCT Receiving Office and given the number PCT/US99/03807, filed February 22, 1999, which claims priority to United States Provisional Patent application 60/075,641, filed February 23, 1998.